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CAMBRIAN FAUNA OF THE TOP SPRINGS LIMESTONE, GEORGINA BASIN.

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ABSTRACT

The Top Springs Limestone, a carbonate unit of the northern Georgina Basin, Northern Territory, Australia, has previously yielded only the trilobite *Redlichia*, indicating an Ordian (early Middle Cambrian) age for at least part of the formation. New collections of trilobites, brachiopods, hyoliths, molluscs and sponges - fifteen species in all - are described here, leading to the possibility that upper parts of the formation may have been deposited during the succeeding early Templetonian stage. The fauna has a clear affinity with that in the Tindall Limestone of the Daly Basin, and to a lesser extent with the Panton Formation fauna of the Ord Basin. The new helcionellid molluscan genus *Kutanjia ngalbala* and new species *Igorella durara* are also described.

KEYWORDS: Cambrian, Northern Territory, Georgina Basin, Trilobita, Brachiopoda, Hyolitha, Mollusca, Porifera.

INTRODUCTION

The Top Springs Limestone is a flat-lying Cambrian carbonate unit in the northeastern Northern Territory, occupying portions of the Bauhinia Downs and Wallhallow 1:250 000 map sheet areas (Smith 1964; Plumb and Rhodes 1964). In outcrop it generally rests with probable disconformity on the Bukalara Sandstone (Dunn 1963), which bears the vertical dwelling burrow *Skolithos* throughout and is thus regarded as Early Cambrian in age. These two units together represent the northernmost extension of the Georgina Basin; connections with the remainder of the basin are obscured by Cretaceous cover (Fig. 1).

Where the Bukalara Sandstone is absent, the Top Springs Limestone mantles Middle Proterozoic rocks of the McArthur Basin. To the south it is unconformably overlain by Cretaceous deposits. Cored drillholes DD83SC-1 and DD86SC-2 (Colliver 1984), in the Wallhallow sheet area, commenced in Cretaceous rocks and intersected a minimum of 80 m and 92 m of Top Springs Limestone respectively before entering vesicular basalt (Antrim Plateau Volcanics equivalent) beneath. These drillholes represent the maximum known stratigraphic thickness of the unit.

Öpik (in Randal and Nichols 1963, Appendix 1) reported a species of *Redlichia* close to *R. forresti* from the vicinity of Top Spring homestead, prompting an Ordian (early Middle Cambrian) age assignment for the Top Springs Limestone.

Recent regional mapping of the Bauhinia Downs sheet area by the Northern Territory Geological Survey (Pietsch *et al.* 1991) was accompanied by palaeontological sampling of the Top Springs Limestone throughout its outcrop area and in drillhole DD83SC-1 (Fig. 2). As a result, in addition to the *Redlichia*, a suite of inarticulate and articulate brachiopods, hyoliths, molluscs, sponges, sponge spicules, chancelloriides, echinoderm ossicles and problematic tubes has been collected. The trilobites, brachiopods, hyoliths, molluscs and sponges are described here, and together demonstrate a clear affinity with the undoubtedly coeval fauna of the Tindall Limestone in the Daly Basin (Kruse 1990). *Redlichia forresti* and *Gudnguwan hardmani* are also shared with the Panton Formation in the Ord Basin (Table 1).

Although *Redlichia*, characteristic of the Ordian stage in northern Australia, is the only trilobite presently known from the Top Springs Limestone, other elements of the fauna such as *Micromitra nerramubawn* and *Diraphora* sp. suggest a slightly younger age, as in the Daly Basin their stratigraphic range is restricted to the upper,

Fig. 1. Locality map of the northern portion of the Northern Territory showing sedimentary basins bearing Cambrian rocks. Black: outcrop areas of Tindall Limestone (Daly Basin) and Top Springs Limestone (northern outlier of Georgina Basin).

early Templetonian interval of the Tindall Limestone. However, *M. nerranubawu* has since been reported from the Coonigan Formation of western New South Wales (Roberts and Jell 1990), where it co-occurs with *Redlichia* and is therefore Ordian. The Top Springs Limestone is a part of the unconformity-bounded Ordian-early Templetonian sediment package recognised elsewhere in the Georgina basin by Shergold *et al.* (1988).

The Top Springs Limestone was introduced by Plumb and Rhodes (1963, 1964) and defined by Kruse (in Pietsch *et al.* 1991). Grey, partially dolomitised mottled and onkoid limestone are prominent in outcrop, with minor grey bioclastic limestone (in places as silicified hyolith-brachiopod coquinas), brecciated limestone, pink to pale brown cryptomicrobial laminite and rare grey fenestral limestone. Patchy or fabric-selective brown silicification is common at surface; preferentially silicified components include individual cryptomicrobial laminations, onkoids and bioclasts.

Contrary to the original drill log interpretation (Colliver 1984: 7), palaeontological sampling has established that the entire cored supra-basalt interval in drillholes DD83SC-1 and DD86SC-2 is Top Springs Limestone. The cryptomicrobial laminites constitute the basal 3-9 m of the formation; these are locally exposed around Rocky and Black Springs Creeks and in the bed of the McArthur River in the northern Wallhallow sheet

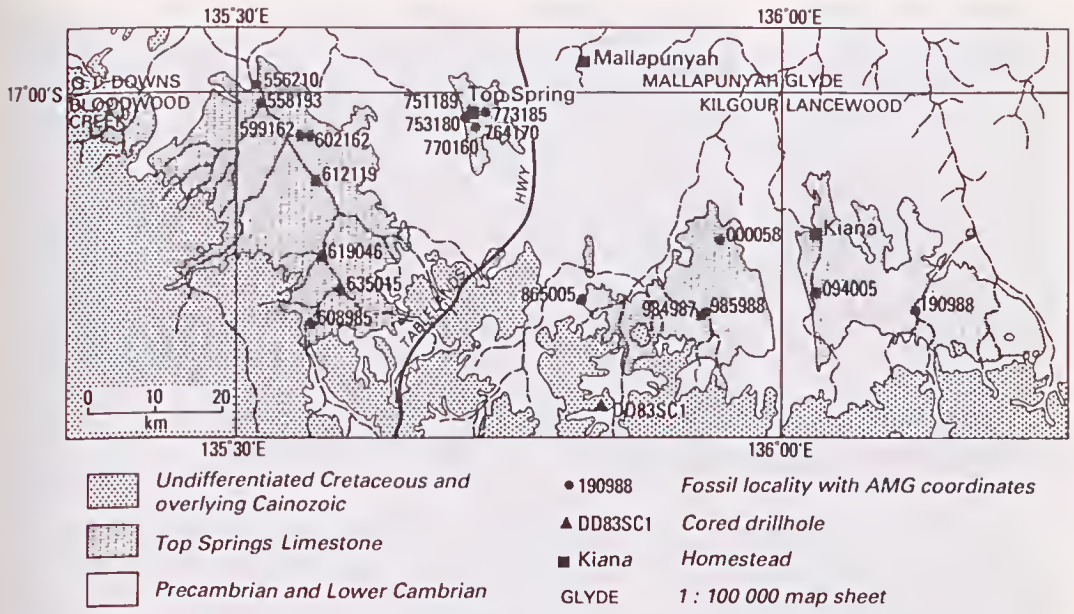

Fig. 2. Geological map of the Top Springs Limestone showing fossil localities. The Bauhinia Downs and Wallhallow 1:250 000 sheet areas are respectively north and south of 17°00'S.

area (Fig. 3A). They range from selectively dolomitised millimetre-scale sedimentary laminations through to more finely crenulated laminites wherein micrite or microspar cryptomicrobial laminations alternate with more thrombolitic cryptomicrobial intervals.

These unfossiliferous cryptomicrobial laminites are immediately succeeded by cryptomicrobial boundstone or packstone (Fig. 3B), in turn succeeded by a variety of grey limestone types. Occurrences of anhydrite suggest an evaporite solution-collapse origin for brecciated limestone intervals.

In thin section, the dominant mottled limestones are identified as bioclastic wackestones (Fig. 3C), with hyolith, trilobite and brachiopod fragments in a bioturbated, patchily dolomitised micrite-peloid matrix. These grade into onkoid wackestones (Fig. 3D) as bioclasts (particularly hyoliths) are progressively coated by *Girvanella*. Grey limestones featureless in hand specimen are seen under the microscope to be peloid grainstones.

Outcrops of all carbonate lithologies are typically subject to karstification, forming pavements, lapies, kamenitza, dolines and towers.

Siliciclastic input was minimal. The Top Springs Limestone is an essentially shallow shelf marine carbonate unit punctuated by one or a few brief peritidal episodes and located away from (seaward of?) the peritidal siliciclastic sedimentary influences affecting the coeval Tindall Limestone to the northwest.

Specimens P91/6-91/156 are lodged in the Northern Territory Museum of Arts and Sciences, Darwin. Additional specimens are contained in twenty six accompanying unnumbered slides. Collecting localities are specified by an Australian Map Grid (AMG) reference and 1:100 000 map sheet (Fig. 2).

Table 1. List of Top Springs Limestone fauna (at left), together with (at right) occurrences in common with the Tindall Limestone (Daly Basin) and Panton Formation (Ord Basin); o=species in common, +=genus in common. Note that Panton Formation brachiopods, molluscs and sponges have not been studied.

TOP SPRINGS LIMESTONE	TINDALL LIMESTONE	PANTON FORMATION
TRILOBITES		
Redlichia forresti (Etheridge)	+	o
BRACHIOPODS		
Westonia ?nyapungensis Kruse	o	
Kyrshabaktella mudedirri Kruse	o	
Hadrotreta djagoran Kruse	o	
Eothele napuru Kruse	o	
Micromitra nerrambawn Kruse	o	
Diraphora sp.	+	
HYOLITHS		
Gudugnwan hardmani (Etheridge)	o	o
MOLLUSCS		
Latouchella cf. *accordionata* Runnegar and Jell	o	
Igorella durara sp. nov.		
Kutanjia ngalbala gen. et sp. nov.		
?enigmaconid indet.		
?scenellid indet.		
SPONGES		
?Jawonya sp.	o	
lithistide indet.	o	

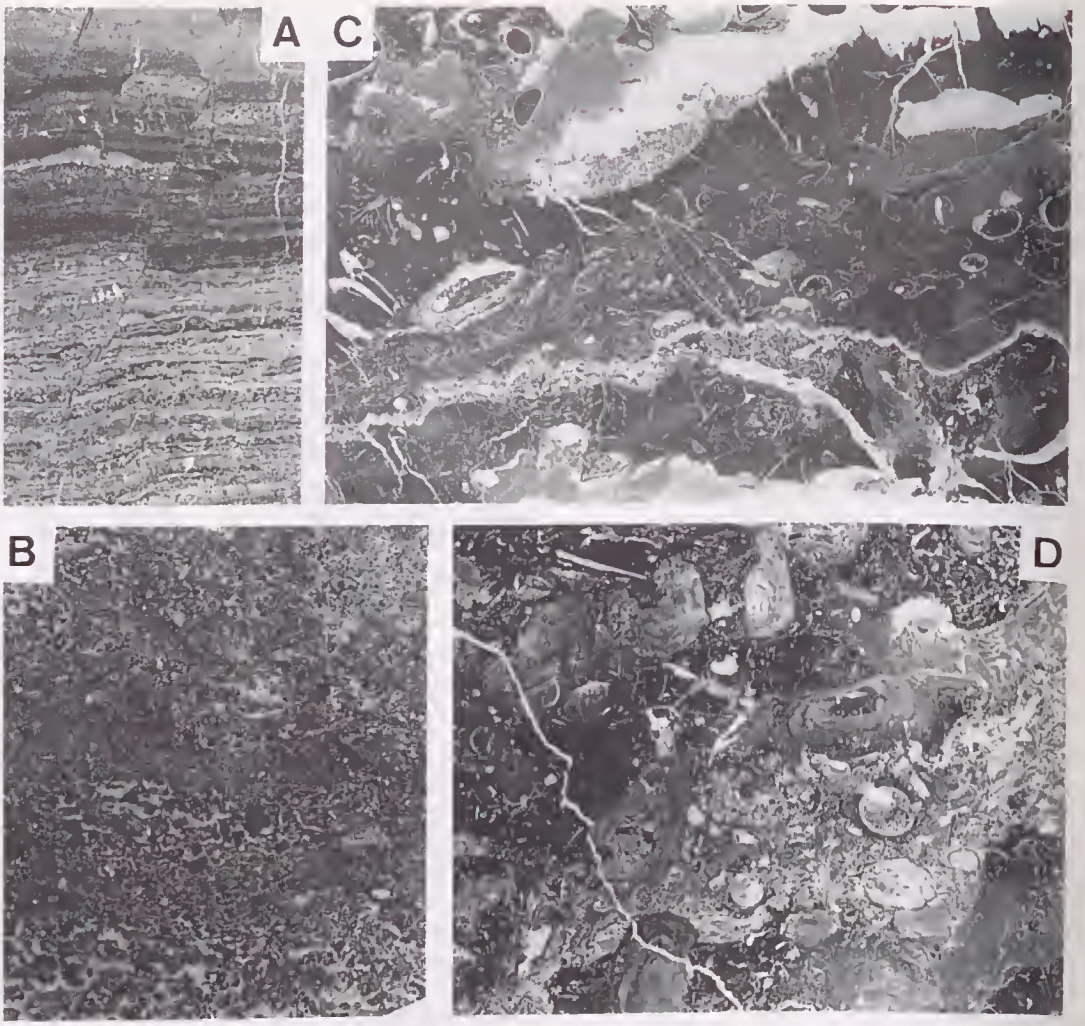

Fig. 3. Top Springs Limestone lithologies: A, basal cryptomicrobial laminite, AMG 586163 KILGOUR; B, thrombolitic limestone grading upward into cryptomicrobial packstone, AMG 967966 KILGOUR; C, common hyolith-trilobite bioclast wackestone; matrix is micrite with fine sand-size peloids; note cavities geopetally floored by micrite, silt or bioclasts, AMG 190988 LANCEWOOD; D, onkoid-bioclast wackestone-packstone, AMG 190988 LANCEWOOD. All x4.

SYSTEMATICS

Class Trilobita Walch
Order Redlichiida Richter
Suborder Redlichiina Richter
Superfamily Redlichiacea Poulsen
Family Redlichiidae Poulsen

Genus *Redlichia* Cossmann, 1902

Type species. *Hoeferia noetlingi* Redlich, 1899 [Middle Cambrian, 'Khussak Group', Salt Range, Pakistan].

Redlichia forresti
(Etheridge in Foord, 1890)
(Fig. 4)

Olenellus ? forresti Etheridge in Foord, 1890: 99-100, pl.4, figs 2, 2a-b.

Redlichia forresti - Öpik 1958: 12-17, 26-32, figs 1-3, 7-8, pl.1, figs 1-3, pl.2, figs 1-4, pl.3, figs 1-4.

'species close to *Redlichia forresti*' - Öpik in Randal and Nichols 1963: appendix 1.

Redlichia forresti - Bergström 1973: 17.

Redlichia forresti - McNamara 1986: 405-406, 408-411, fig. 1A, B, D, F-I.

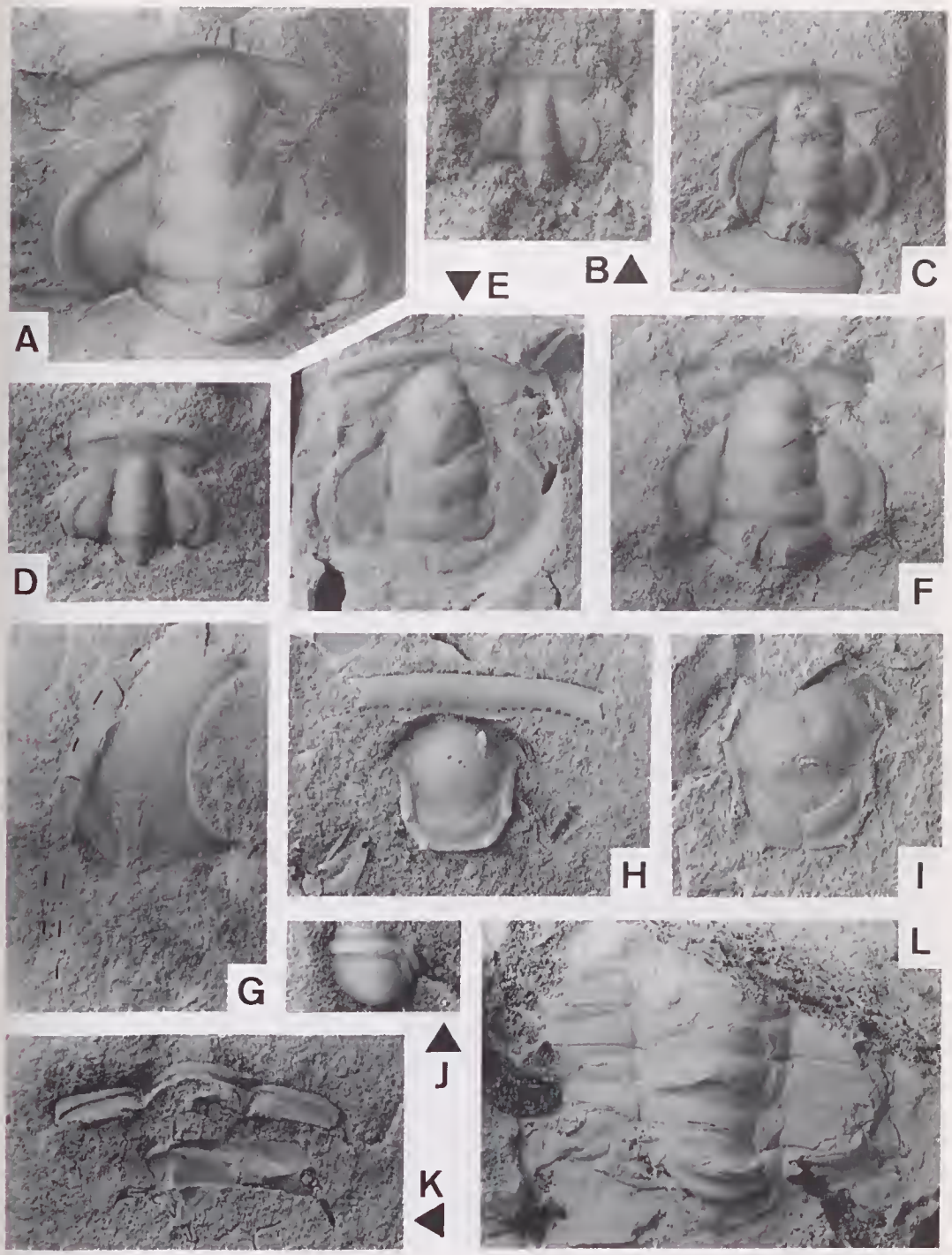

Fig. 4. *Redlichia forresti*: A, cranidium P91/6 x3; B, cranidium P91/7 x10; C, cranidium P91/8 x5; D, cranidium P91/9 x7; E, cranidium P91/10 x3; F, cranidium P91/11 x3; G, free cheek P91/12 x3; H, fused rostral plate and hypostome P91/13 x5; I, hypostome P91/14 x7; J, pygidium P91/15 x8; K, thoracic segments P91/16 x3; L, thoracic segments P91/17 x3. All from AMG 865005 KILGOUR.

Material. Forty three specimens including over forty cranidia, six free cheeks, three hypostomes, six thoracic portions and one pygidium. P91/6-91/48 from AMG 865005 KILGOUR.

Diagnosis. Exoskeleton smooth except for raised lines on rostral plate and hypostome. Frontal limb narrow, width about 95-110% cephalic length, and approximately as wide as fixed cheeks.

Description. Cranidium 88-102% as long as wide; largest 22 mm length. Glabella tapering anteriorly to 65-75% of basal width with rounded anterior. Axial and glabellar furrows shallow, with slightly deeper pits at junctions. S0 transverse, continuous; S1 rarely continuous. L0 subcrescentic.

At level of S1, fixed cheeks half glabellar width. Palpebral furrow distinct, of uniform depth and width. Palpebral lobes one-third of maximum interocular cheek width. Posteriorly, palpebral lobes separated from axial furrow by gap equal to or slightly greater than width of lobes. Frontal limb width 95-110% of cephalic length: subequal to maximum width of fixed cheeks. Frontal area length (sag.) 10-30% glabellar length. Preglabellar field represents about half of frontal area length in juvenile specimens (less than 12 mm length); glabella reaches anterior border furrow in larger cranidia. Anterior border convex, of uniform length (sag.) throughout. Posterior border furrow shallow; posterior limbs not exposed. Preocular facial suture divergent at 55-60° to sagittal line.

Free cheek rising gently from broad, shallow border furrows to low eye socle. Border convex dorsally. Genal spine advanced, subtending 50° between spine and posterolateral border.

Rostral plate and hypostome fused. Rostral plate wide, as long as border, with comarginal terrace lines anteriorly, and a row of 10-12 pits lateral to hypostome on either side (Fig. 4H). Corresponding pits are present in anterior border furrows of some cranidia. Hypostome with median body divided by median furrow into distinct convex anterior lobe and flatter posterior lobe; median furrow subparallel to posterior border of hypostome. Shallow but clearly impressed border furrow laterally and posteriorly. Border convex, of uniform width, with comarginal terrace lines in some specimens. Posterolateral border with two pairs of short marginal spines.

Thoracic segments with falcate pleural spines, diagonal pleural furrow and, at least in some, a median tubercle.

Pygidium small, moderately vaulted. Anterior segment well defined; second segment poorly defined. Central portion of pygidium is a moderately vaulted convexity, without subdivision.

Remarks. *Redlichia forresti* belongs to a cohort of Australian *Redlichia* species recognised by Öpik (1970), also including *R. idonea* Whitehouse, 1939 and *R. advialis* Öpik, 1970, having a relatively narrow frontal limb (100-110% of cephalic length) and a smooth to weakly ornamented cephalon. Öpik (1970) recorded the latter two species from the Georgina Basin in western Queensland. *Redlichia idonea* is distinguished by its slightly narrower fixed cheeks, with the posterior tips of the palpebral lobes terminating closer to the occipital lobe. In *R. advialis*, each thoracic segment, as well as the occipital lobe, possesses a spine or low nodal process, whereas in *R. forresti*, spines are present only on the fourth and twelfth segments. Most thoracic segments in the Top Springs Limestone collection lack such processes.

According to Öpik (1970), pygidia of both *R. forresti* and *R. idonea* have attached ankylosed thoracic segments, but not so *R. advialis*. However, McNamara (1986) mentions ankylosed segments attached to only two of four topotype pygidia of *R. forresti*.

The present comparison of the Top Springs Limestone form with *R. forresti* is based on the description by Öpik (1958), together with a topotype collection from the Linnekar Limestone of the Ord Basin. The only evident differences are the median dorsal groove along most, but not all genal spines in Linnekar Limestone specimens (absent in those from the Top Springs Limestone), and the lack of an ankylosed segment in the one Top Springs Limestone pygidium available. This latter pygidium is unlike those of *R. forresti* figured by Öpik (1958), but has the same basic plan as topotype pygidia figured by McNamara (1986).

The terrace lines on the rostral plate and hypostomal border of some Top Springs Limestone specimens are paralleled by similar ornament observed on some free cheek and pleural doublures in the Linnekar Limestone collection.

The *Redlichia* sp. from the Tindall Limestone (Kruse 1990) has a relatively wider frontal limb with longer (sag.) anterior border, and probably represents a separate species.

Phylum Brachiopoda Duméril
Class Inarticulata Huxley
Order Lingulida Waagen
Superfamily Lingulacea Menke
Family Obolidae King
Subfamily Lingulellinae Schuchert

Genus *Westonia* Walcott, 1901

Type species. *Lingula aurora* Hall, 1861 [Late Cambrian, North America].

***Westonia ?nyapungensis* Kruse, 1990**
(Fig. 5)

? *Westonia nyapungensis* Kruse, 1990: 24, fig. 13, pl.9 [cum syn.].

Material. Six specimens. Pedicle valves P91/49-91/51 from AMG 773185 KILGOUR; brachial valves P91/52-91/54 from AMG 773185 KILGOUR.

Description. Biconvex, both valves elongate ovoid, with ornament of fine concentric growth lines and regularly disposed coarser growth la-

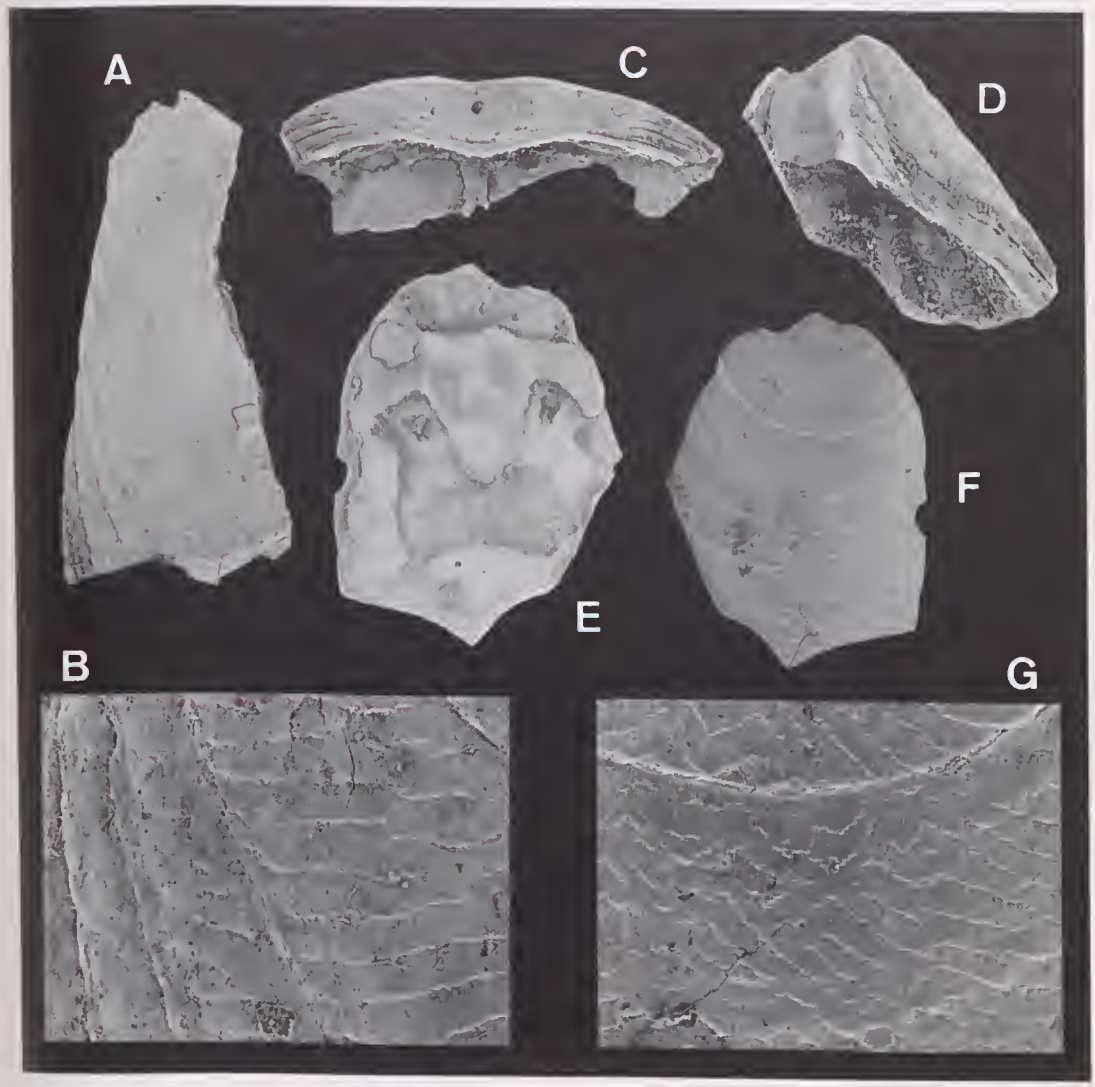

Fig. 5. *Westonia ?nyapungensis*: **A-B**, pedicle valve P91/49: **A**, external view x15; **B**, detail of ornament near lateral margin of valve showing continuous ridges (horizontal) cut by growth lines (vertical) x60; **C**, brachial valve P91/52, internal view showing pseudointerarea x18; **D**, pedicle valve P91/50, internal view showing pseudointerarea and pedicle groove (at left) x25; **E-G**, pedicle valve P91/51: **E**, internal view x15; **F**, external view x15; **G**, detail of ornament on midline of valve showing zigzag interference pattern x60. All from AMG 773185 KILGOUR.

mellae; superimposed asymmetric ridges in two fields concentric about posterior tips of propareas; fields interface along median area of both valves as zigzag interference pattern (Fig. 5G).

Pedicle valve with rounded anterior margin and near-straight posterolateral margins, latter subtending apical angle of about 85°. Pseudointerarea slightly anacline, divided by anteriorly expanding pedicle groove. Propareas divided by flexure lines diverging from beak. Striations of proparea extend indistinctly across pedicle groove; superimposed straight striations on groove floor are aligned parallel to valve plane of symmetry. Visceral field extremely shallow (Fig. 5E). Posterolateral muscle scars elongate, arising beneath propareas.

Brachial valve with prominent orthocline pseudointerarea having broad, depressed median segment; margins of depression ill-defined. Low median ridge arises from beneath median segment (Fig. 5C).

Remarks. The species is here represented only by fragments, many of which are internally abraded. As only posterior portions of both valve interiors are known, the material is assigned to *nyapungensi* with question.

The only other known Australian Cambrian member of the genus is the coeval *W. cymbricensis* Roberts, from the Coonigan Formation of western New South Wales, which differs from *nyapungensis* in having, in the pedicle valve, a wider pseudointerarea, a deeper pedicle groove and much broader vascula lateralia, and in the brachial valve, a more acute beak (Roberts and Jell 1990).

Family Zhanatellidae Koneva

Genus *Kyrshabaktella* Koneva, 1986

Type species. *Kyrshabaktella certa* Koneva, 1986 [Middle Cambrian (Amgan), Kuyandin suite, Kyrshabakta River, Malyy Karatau, Kazakhstan, USSR].

Kyrshabaktella mudedirri Kruse, 1990
(Fig. 6A-G)

Kyrshabaktella mudedirri Kruse, 1990: 25, fig. 14, pl.10.

Material. Eleven specimens. Pedicle valves P91/55 from AMG 984987 KILGOUR, P91/56 from AMG 773185 KILGOUR, P91/57 from AMG 094005 LANCEWOOD; brachial valves P91/58-91/60 from AMG 094005 LANCEWOOD, P91/61 from AMG 753180 KILGOUR, P91/62 from AMG 190988 LANCEWOOD, P91/63-91/65 from AMG 602162 KILGOUR.

Description. Valves rounded longitudinally subtriangular in outline. Pedicle valve beak area bears a semicircular to tear-shaped opening (emarginatura) which breaches posterior valve margin. Valve gently convex in lateral profile, slightly more strongly rounded posteriorly. Brachial valve with marginal beak, umbonal region inflated above adjacent lateral flanks; convex in lateral profile, more strongly rounded posteriorly.

Pedicle valve pseudointerarea divided by emarginatura into two discrete anacline, subtriangular propareas, each proparea divided by an anterolateral flexure line into an adnate lateral portion and a free portion projecting inward from shell margin (Fig. 6D). Valve interior marked by fine radial striae; clearly marked furrows of baculate vascula lateralia extend anterolaterally from emarginatura; paired elongate posterior muscle scars lateral to these. Paired transversely oriented central muscle scars present at about 40% valve length from beak; other possible paired scars posterior of these (Fig. 6B).

Brachial valve with apsacline pseudointerarea closely adnate to inner surface of valve; propareas broad, separated by deeply concave diamond-shaped median plate whose anterior margin is slightly but clearly elevated above valve floor. Prominent median ridge extends anteriorly to about midlength; anterior of this, it trifurcates into a median low ridge, which may extend to near anterior margin, flanked by much shorter and less distinct lateral ridges. Paired elongate posterior muscle scars immediately adjacent to propareas; smaller paired central muscle scars located medially, astride extension of median ridge, at terminations of lateral ridges. Fine radial striae may cover entire valve interior.

Remarks. The genus is otherwise known only from Siberia and Kazakhstan. The type species *K. certa* is distinguished by the raised visceral field in some pedicle valves, while in the brachial valve, the median ridge extends almost to the anterior margin.

SEM examination of the shell microstructure discloses intercalated laminar and columnar layers beneath a smooth, unpitted external surface (Fig. 6C). Laminar microstructure is characteristic of the genus, and serves to distinguish it from the related Late Cambrian genus *Dysoristus* Bell, which has a pitted external surface and a microstructure of crosscutting needles (L.E. Popov, pers. comm. 1990).

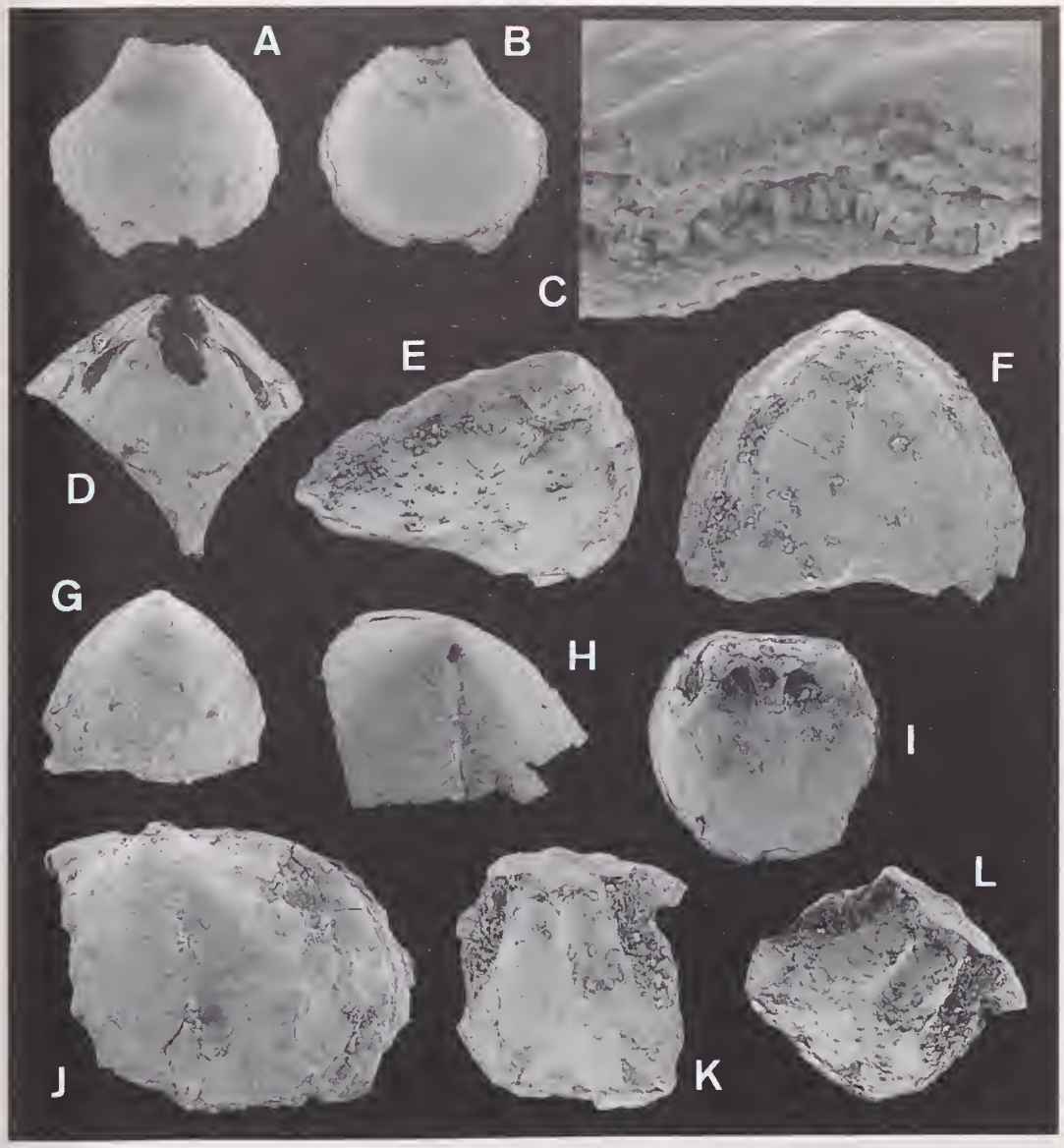

Fig. 6. *Kyrshabaktella nudedirri*: **A-C**, pedicle valve P91/55 from AMG 984987 KILGOUR: **A**, external view x25; **B**, internal view x25; **C**, detail of shell microstructure showing intercalated laminar and columnar layers x2000; **D**, pedicle valve P91/56 from AMG 773185 KILGOUR, internal view showing pseudointerarea, emarginatura (enlarged by shell breakage) and musculature x40; **E-F**, brachial valve P91/58 from AMG 094005 LANCEWOOD: **E**, oblique internal view x25; **F**, normal internal view x25; **G**, brachial valve P91/59 from AMG 094005 LANCEWOOD, external view x25. *Hadrotreta djagoran*: **H**, pedicle valve P91/66 from AMG 094005 LANCEWOOD, oblique external view showing pedicle foramen and pseudointerarea x40; **I**, pedicle valve P91/67 from AMG 612119 KILGOUR, internal view x60; **J**, brachial valve P91/70 from AMG 094005 LANCEWOOD, external view x40; **K-L**, brachial valve P91/71 from AMG 094005 LANCEWOOD: **K**, normal internal view x40; **L**, oblique internal view x40.

Order Acrotretida Kuhn
Suborder Acrotretidina Kuhn
Superfamily Acrotretacea Schuchert
Family Acrotretidae Schuchert
Subfamily Acrotretinae Schuchert

Genus *Hadrotreta* Rowell, 1966

Type species. *Acrotreta primaeva* Walcott, 1902 [Early-Middle Cambrian (upper *Bonnia-Olenellus* Zone to pre-*Albertella* beds), Pioche Shale, Pioche, Nevada, USA].

Hadrotreta djagoran Kruse, 1990
(Fig. 6H-L)

Hadrotreta djagoran Kruse, 1990: 29, fig.15, pl.11 [cum syn.].

Material. Eight specimens. Pedicle valves P91/66 from AMG 094005 LANCEWOOD, P91/67 from AMG 612119 KILGOUR, P91/68-91/69 from AMG 094005 LANCEWOOD; brachial valves P91/70-91/73 from AMG 094005 LANCEWOOD.

Description. Ventribiconvex, valves transversely suboval in outline. Pedicle valve subconical, proeline, beak forming highest point of valve; pseudointerarea a gentle concave flexure of valve, with beak slightly overhanging subrounded pedicle foramen, divided medially by narrow intertrough (Fig. 6H). Growth lines traverse intertrough generally without interruption. Brachial valve low convex; beak marginal, inflated above adjacent lateral flanks and bounded by gentle but clearly defined furrows extending anterolaterally from apex.

Pedicle valve interior with low bosslike apical process merging gently with valve floor anteriorly and laterally. Internal pedicle opening rounded, flush with surface of apical process. Cardinal muscle scars subelliptical on posterolateral slopes of valve. Baculate vascula lateralia arise near lateral margins of apical pits and extend anterolaterally as shallow furrows.

Brachial valve interior with short pseudointerarea, medial one-third of which is a sharply defined apsacline median plate; flanking propareas approximately orthocline. Median buttress and median ridge are low, colinear structures separated by a low col; anteriorly, median buttress flares out as a low platform enclosing a pair of sunken areas, possibly anterior muscle scars, straddling median ridge. Cardinal muscle scars subelliptical, each bounded on its inner margin by raised low ridge.

Remarks. Roberts and Jell (1990) have identified an Ordian form from the Coonigan Formation of western New South Wales as the type species *H. primaeva*, otherwise known from Nevada, USA. Compared to *H. djagoran*, the New South Wales form has a more rounded valve outline, with a clearly different configuration of the brachial valve median buttress-ridge system, wherein the median ridge is much more prominent.

Family Acrothelidae Walcott and Schuchert

Genus *Eothele* Rowell, 1980

Type species. *Acrothele spurri* Walcott,1908 [Early Cambrian (*Bonnia-Olenellus* Zone), Combined Metals Member of Pioche Shale, Pioche, Nevada, USA].

Eothele napuru Kruse, 1990
(Fig. 7A-E)

Eothele napuru Kruse, 1990: 31, fig.16, pl.12.

Material. Eleven specimens. Pedicle valves P91/74-91/82 from AMG 612119 KILGOUR, P91/83 from AMG 773185 KILGOUR; brachial valves P91/84 from AMG 612119 KILGOUR.

Description. Shell subcircular, both valves low. Apart from bare pseudointerarea (with growth lines only) astride pedicle foramen, both valves have ornament of pustulose granules and concentric growth lines.

Pedicle valve a low eccentric cone. Lateral and anterior slopes of apex generally slightly concave in profile; pseudointerarea proeline. External pedicle foramen slitlike, commencing as rounded indentation in larval shell margin and continuing to preserved margin. Larval shell transversely ovoid, approximate length 0.4 mm and width 0.35 mm, with a pair of smoothly rounded knobs anteriorly; a prominent hood at posterior margin overhangs pedicle foramen. Pedicle valve interior poorly preserved; raised cardinal muscle scars preserved posterolaterally in some specimens.

Brachial valve gently convex. Larval shell transversely ovoid, approximate length 0.4 mm and width 0.3 mm, bearing a pair of longitudinally oriented ridges. At midpoint of each ridge is a hemispherical dome surmounted by a knoblike protuberance. Valve interior with median septum extending anteriorly from posterior margin; a broad, low, smoothly rounded, anteriorly expanding ridge extends from anterior termination of septum. Vascula lateralia extend anterolaterally from posterior valve margin.

Remarks. Although pedicle valve internal surfaces are poorly preserved, available fragments are sufficient for confident identification as *E. napuru*. *Eothele granulata* Roberts from the Coonigan Formation of western New South Wales is easily distinguished by its much more promi-

nent pedicle valve apex and commonly enclosed pedicle foramen (Roberts and Jell 1990).

Order Paterinida Rowell
Superfamily Paterinacea Schuchert
Family Paterinidae Schuchert

Genus *Micromitra* Meek, 1873

Type species. ?*Iphidea sculptilis* Meek, 1873 [Middle Cambrian, Meagher Limestone, Montana, USA].

***Micromitra nerranubawu* Kruse, 1990**
(Fig. 7F-H)

Micromitra nerranubawu Kruse, 1990: 35, fig.17, pls 13-14 [cum syn.].*Micromitra nerranubawu* - Roberts and Jell 1990: 297, figs 30-31.

Material. Two specimens. Pedicle valves P91/85-91/86 from AMG 612119 KILGOUR.

Description. Pedicle valve strongly convex, ornament of concentric fila disrupted by radial costellae. Apex prominent, bulbous, overhanging

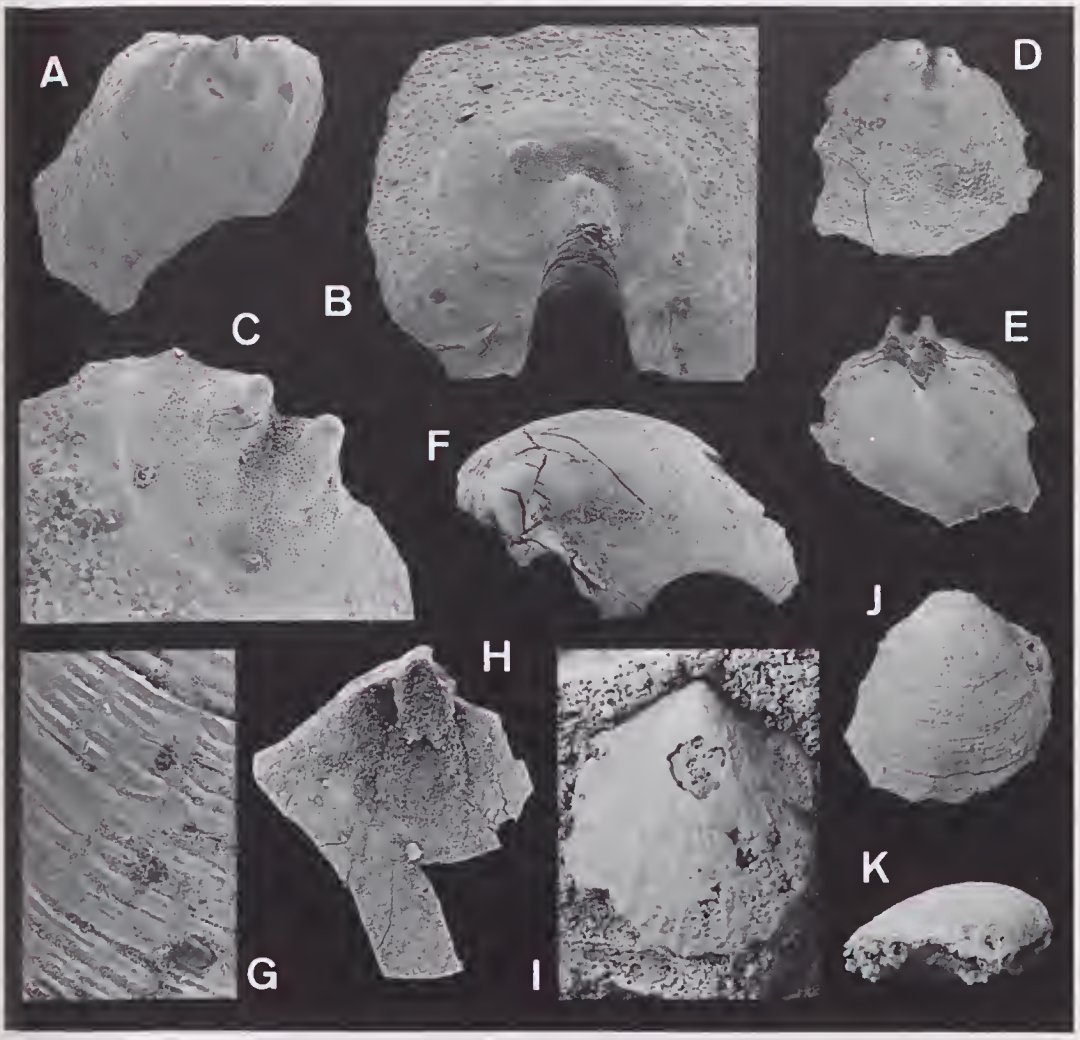

Fig. 7. *Eothele napuru*: **A-B**, pedicle valve P91/74 from AMG 612119 KILGOUR: **A**, external view x40; **B**, oblique view of larval shell and proximal pedicle foramen x90; **C-E**, brachial valve P91/84 from AMG 612119 KILGOUR: **C**, detail of larval shell in oblique view x100; **D**, external view x40; **E**, internal view x40. *Micromitra nerranubawu*: **F-G**, pedicle valve P91/85 from AMG 612119 KILGOUR: **F**, oblique posterior external view showing apex and incomplete homeodeltidium x25; **G**, detail of external ornament showing concentric fila and radial costellae x200; **H**, pedicle valve P91/86 from AMG 612119 KILGOUR, internal view x25. *Diraphora* sp.: **I**, pedicle valve P91/87 from AMG 984987 KILGOUR, external view x3; **J-K**, pedicle valve P91/88 from AMG 984987 KILGOUR: **J**, external view x3; **K**, lateral view x3.

procline, broadly flared homeodeltidium. Apical angle about 115° in commissural plane. Posterior margin externally bearing finely striated propareas and internally smooth. Valve interior with a low apical platform bearing raised lateral margins; pair of wide submedian ridges (mantle canals?) extends anteriorly from platform.

Remarks. The internal apical platform is observed in the holotype (Kruse 1990: pl. 13D), in which it is poorly preserved. Possible mantle canals, linear depressions in the holotype, are represented by raised ridges in the Top Springs Limestone specimen illustrated in Fig. 7H. The brachial valve is not represented in the Top Springs Limestone collection.

Roberts and Jell (1990) record the species from the Coonigan Formation of western New South Wales.

Class Articulata Huxley
Order Orthida Schuchert and Cooper
Suborder Orthidina Schuchert and Cooper
Superfamily Orthacea Woodward
Family Eoorthidae Walcott

Discussion. Kruse (1990) followed Havlicek (1977) in assigning *Diraphora* and *Wimanella* to the Bohemiellidae Havlicek, 1977, a Middle to Late Cambrian family of orthaceans in which the pedicle valve muscle field is confined to the delthyrial cavity. However, as Roberts and Jell (1990) note, in these genera the muscle scars extend well anterior of the delthyrial cavity, and are better placed in the Eoorthidae.

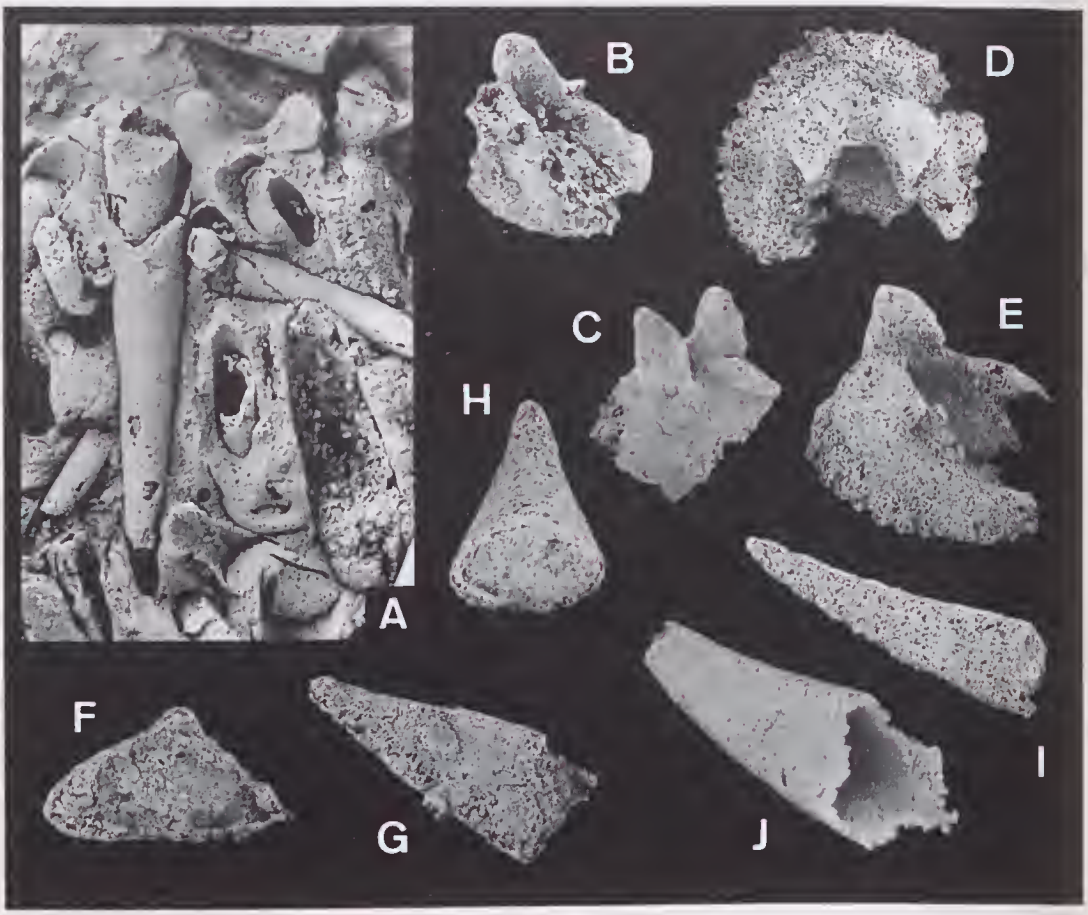

Fig. 8. *Gudaguwan hardmani*: **A**, collection of conchs P91/91 x3; **B**, operculum P91/93, oblique internal view x12; **C**, operculum P91/94, oblique internal view showing lateral flanges x12; **D-E**, operculum P91/95; **D**, internal view x16; **E**, oblique internal view x16. All from AMG 984987 KILGOUR. hyoliths indet.: **F-G**, conch P91/112 from AMG 608985 KILGOUR; **F**, sharply triangular transverse section x12; **G**, oblique view x9; **H-I**, conch P91/113 from AMG 608985 KILGOUR; **H**, oblique apertural view showing rounded-triangular transverse section and convex venter x12; **I**, oblique view x9; **J**, conch P91/114 from AMG 984987 KILGOUR, oblique view x9.

Genus *Diraphora* Bell, 1941

Type species. *Eoorthis bellicostata* Walcott, 1924 [Middle Cambrian, Burgess Shale, Field, British Columbia, Canada].

Diraphora sp.
(Fig. 7I-K)

Material. Four specimens. Pedicle valves P91/87-91/89 from AMG 984987 KILGOUR; brachial valves P91/90 from AMG 984987 KILGOUR.

Description. Biconvex, anterior commissure rectimarginate to slightly uniplicate. Ornament finely costellate to more coarsely parvicostellate, together with clear concentric growth lines. Pedicle valve moderately convex with prominent recurved beak; interarea slightly concave; delthyrial cavity deep. Brachial valve gently convex.

Remarks. The pedicle valve is represented by silicified externals and free silicified fragments of the posterior preserving the interareas only. Brachiophores, teeth and other internal features are not known. The brachial valve is known only from one incomplete external mould.

'Phylum Hyolitha'
Class Orthothecimorpha Sysoyev
Order Exilithecida Sysoyev
Family Larawidae Kruse

Genus *Guduguwan* Kruse, 1990

Type species. *Salterella hardmani* Etheridge in Foord, 1890 [Middle Cambrian (Ordian), Panton Formation, Mt Panton, Northern Territory, Australia].

Guduguwan hardmani
(Etheridge in Foord, 1890)
(Fig. 8A-E)

Salterella hardmani Etheridge in Foord, 1890: 98, pl.4, fig.1.

Guduguwan hardmani - Kruse 1990: 43, figs 21B, 22, pl.19 [cum syn.].

Material. About one hundred and fifty specimens. Conchs P91/91-91/102 from AMG 984987 KILGOUR; opercula P91/103-91/111 from AMG 984987 KILGOUR.

Description. Conch straight or nearly so, narrow (angle of apical divergence about 8o); largest specimen of length 23 mm and diameter 5 mm; transverse section circular or nearly so. External sculpture poorly preserved, of indistinct transverse growth lines only.

Operculum planar, up to about 3 mm diameter, with planar margin and without clearly defined dorsal and ventral sectors. Dorsally eccentric apex corresponds to conical depression on external surface. On internal surface, platform is represented by a pair of lateral ridges rising to apex; junction of ridges with opercular margin smooth, ill-defined, with narrow dorsal and lateral rim. An inclined lateral flange projects inward from each ridge. Apex surmounted in some cases by indistinct apical node, consistently flanked by a pair of large, rounded lateral processes projecting up to 1.5 mm above their supporting ridges. Lateral processes range in orientation from upright (Fig. 8D-E) to inclined (Fig. 8B).

Remarks. The species is now known from the Ord Basin (Panton Formation), Daly Basin (Tindall Limestone) and northern Georgina Basin (Top Springs Limestone). Other reported occurrences remain doubtful.

At least three other hyoliths are represented in the collection: a conch of sharply triangular transverse section (Fig. 8F-G); a conch of rounded-triangular transverse section and convex venter (Fig. 8H-I); and a conch of rounded-triangular transverse section and slightly concave venter (Fig. 8J). As details of ornament, ligula or septa are unknown, these specimens cannot be identified even to class level. The first is comparable to *Ngauki wumirri* Kruse, 1990, while the third is not unlike the indeterminate hyolithide figured by Kruse (1990, pl. 22) from the Tindall Limestone.

Phylum Mollusca Cuvier
Class Monoplacophora Knight
Order Cyrtonellida Horny
Superfamily Helcionellacea Wenz
Family Helcionellidae Wenz

Genus *Latouchella* Cobbold, 1921

Type species. *Latouchella costata* Cobbold, 1921 [Early Cambrian (Atdabanian), Comley, Shropshire, England].

Latouchella cf. *accordiouata*
Runnegar and Jell, 1976
(Fig. 9A-F)

cf. *Latouchella accordionata* Runnegar and Jell, 1976: 127, fig. 10C. 1-18.*Latouchella* cf. *accordionata* - Kruse 1990: 48, pl. 23 [cum syn.].

Material. Ten specimens. P91/115-91/124 from AMG 608985 KILGOUR.

Description. Tall, laterally compressed univalves up to 3 mm in length and height, with prominent angular comarginal rugae; fine radial threads visible on some specimens. Rugae poorly developed along convex (dorsal) brow of shell. Aperture subelliptical to subrectangular, with a pair of radial ridges anteriorly on internal surface (Fig. 9E); aperture planar or with slight anterior gape.

Remarks. The Top Springs Limestone specimens match those from the Tindall Limestone (Kruse 1990) in coiling style and spacing of rugae. *L. accordionata*, from the Coonigan Formation of western New South Wales, has tighter coiling in the proximal portion of the shell, and in general, more closely spaced rugae. One exception is the specimen depicted in Fig. 10C, 9-10 of Runnegar and Jell (1976), which is virtually indistinguishable from the specimen in Fig. 9F herein.

Genus *Igorella* Missarzhevskiy in Rozanov *et al.*, 1969

Type species. *Igorella ungulata* Missarzhevskiy in Rozanov *et al.*, 1969 [Early Cambrian (Tommotian, *N. sunnaginicus* Zone), Fomich River, Anabar Massif, USSR].

Igorella durara sp. nov.
(Fig. 9G-O)

Material. Twelve specimens. HOLOTYPE - P91/125; PARATYPES - P91/126-91/136 from AMG 608985 KILGOUR.

Diagnosis. Shell relatively smooth.

Description Moderately tall, slightly laterally compressed univalves up to nearly 4 mm in length, smooth or with indistinct coarse comarginal plications expressed both internally and externally; rarely with faint radial ornament near apex. Aperture planar, elliptical. Apex rostriform, ventrally directed, generally overhanging anterior lip of aperture.

Etymology. From Kutanji aboriginal *durara* (stress on first syllable) = limestone; after the Top Springs Limestone.

Remarks. The similarly shaped *I. ungulata* differs in its stronger ornament of comarginal growth lines or plications, together with fine radial ribs posteriorly. Middle Cambrian *I. insulcata* (Rasetti, 1957) from British Columbia has tighter coiling in the apical portion of the shell.

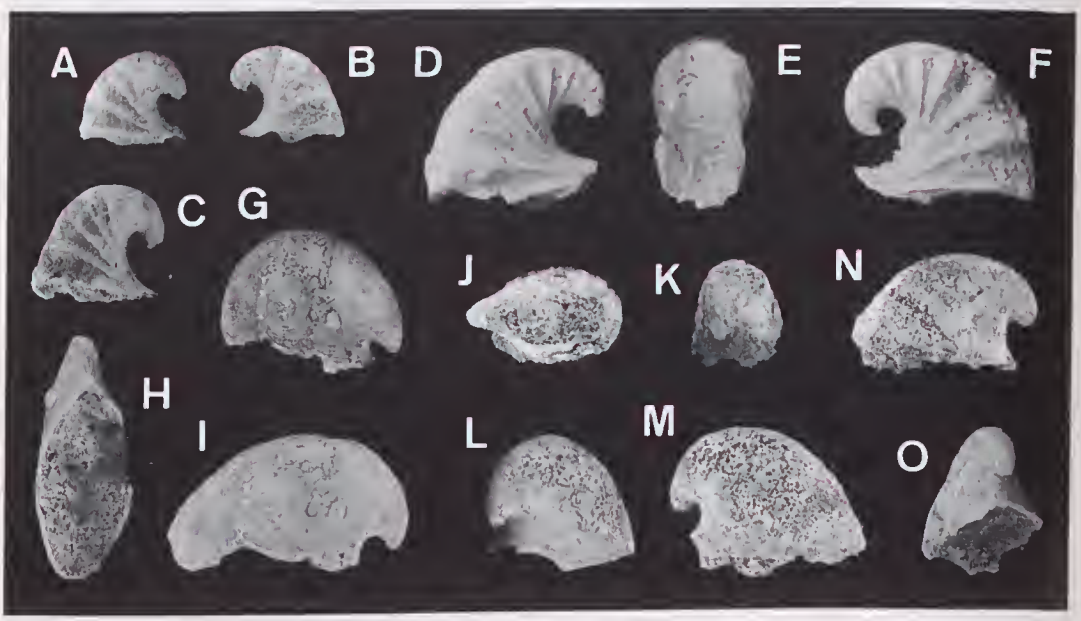

Fig. 9. *Latouchella* cf. *accordionata*: **A**, valve P91/115, lateral view x9; **B**, valve P91/116, lateral view x9; **C**, valve P91/117, lateral view x9; **D-E**, valve P91/118: **D**, lateral view x8; **E**, apertural view showing pair of radial ridges anteriorly on internal surface x8; **F**, valve P91/119, lateral view x8. All from AMG 608985 KILGOUR. *Igorella durara*: **G-I**, holotype P91/125: **G**, oblique view x10; **H**, apertural view x10; **I**, lateral view x10; **J-K**, paratype P91/126: **J**, dorsal view x10; **K**, oblique view x10; **L-M**, paratype P91/127: **L**, oblique view x10; **M**, lateral view x10; **N-O**, paratype P91/128: **N**, lateral view x10; **O**, oblique apertural view x10. All from AMG 608985 KILGOUR.

Tommotian *Bemella* Missarzhevskiy in Rozanov *et al.*, 1969 is a closely related genus, differing principally in having stronger rugae, an ovoid aperture and a more rounded apex. The type species, *B. jacutica*, co-occurs with *I. ungulata* in the latter's type locality.

Sacciconus Jiang, 1980 and *Securiconus* Jiang, 1980 from the Meishucunian of South China have similar morphology, but are known only from steinkerns. They may be synonyms of *Igorella*, *Bemella* or related helcionellids.

Genus *Kutanjia* gen. nov.

Type species. *Kutanjia ngalbala* sp. nov. [Middle Cambrian (Ordian), Top Springs Limestone, Mallapunyah, Northern Territory, Australia].

Diagnosis. Shell planispiral, of approximately one whorl. Aperture planar, subellitical to subrectangular. Exterior smooth or weakly ornamented. Interior with riblike comarginal thicknings.

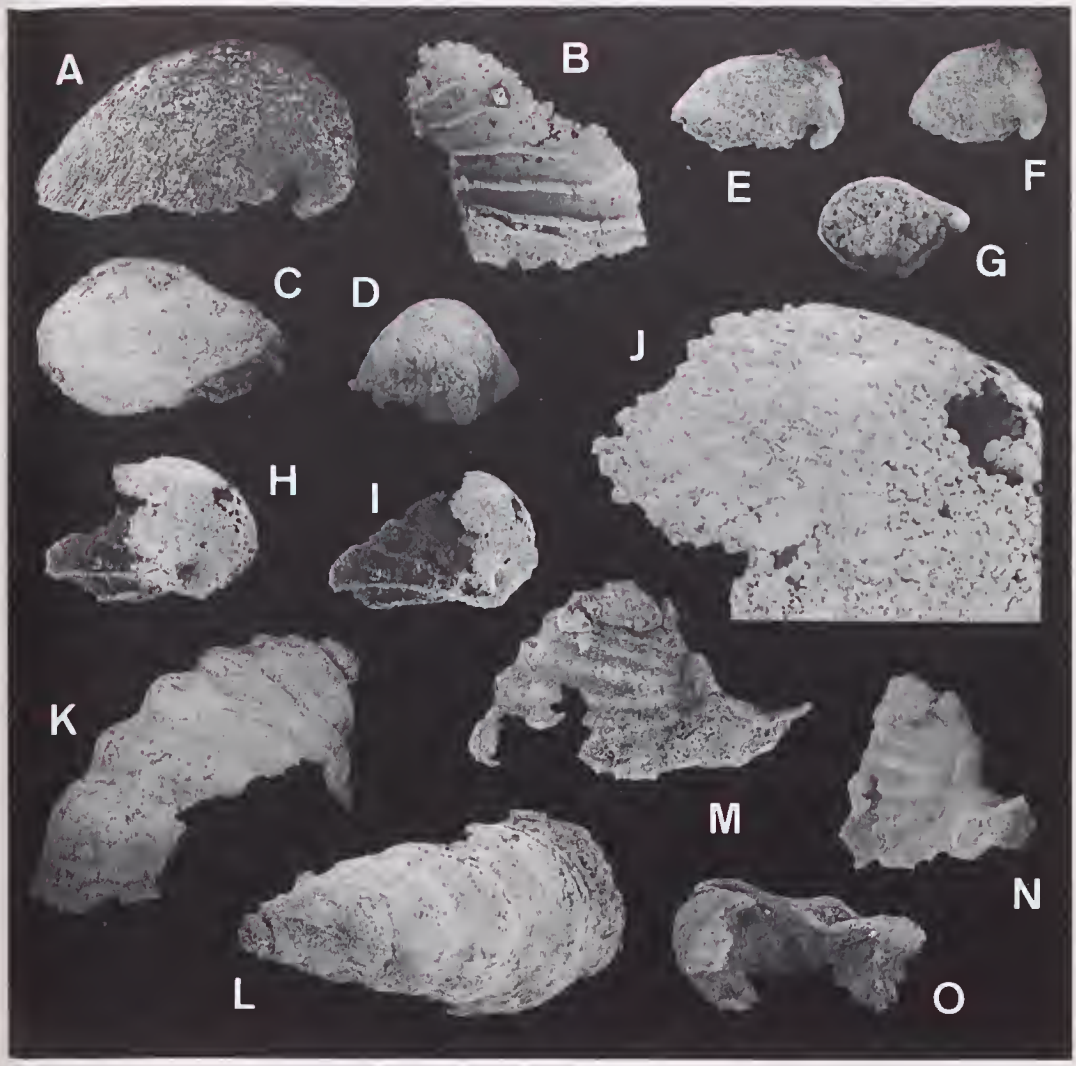

Fig. 10. *Kutanjia ngalbala*: **A**, paratype P91/138 from AMG 608985 KILGOUR, lateral view x17; **B**, paratype P91/139 from AMG 602162 KILGOUR, internal view showing comarginal ridgelike thickenings x17; **C-D**, paratype P91/140 from AMG 608985 KILGOUR: **C**, dorsal view x10; **D**, oblique view x10; **E-G**, paratype P91/141 from AMG 608985 KILGOUR: **E**, lateral view x10; **F**, oblique view x10; **G**, apertural view x10; **H-J**, holotype P91/137 from AMG 608985 KILGOUR: **H**, lateral view x10; **I**, oblique lateral view showing comarginal ridgelike thickenings x10; **J**, detail showing external ornament x40. ?scenellid indet.: **K-L**, valve P91/153 from AMG 608985 KILGOUR: **K**, lateral view x10; **L**, dorsal view x10. ?enigmaconid indet.: **M-O**, valve P91/152 from AMG 608985 KILGOUR: **M**, lateral view x10; **N**, oblique view x10; **O**, oblique apertural view x10.

Etymology. After the Kutanji aboriginal people (stress on second syllable), traditional inhabitants of the region.

Discussion. Runnegar (in Bengtson *et al.* 1990) has assigned two helcionellid species bearing comarginal ridgelike thickenings on the shell interior to *Mackinnonia* Runnegar in Bengtson *et al.*, 1990 and ?*Leptostega* Geyer, 1986. They are from the Parara and Ajax Limestones and Oraparinna Shale of South Australia, of Atdabanian-Botomian age. Both forms are only slightly cyrtoconic, and their thickenings much wider and more rounded than in the new genus.

Kutanjia ngalbala sp. nov.
(Fig. 10A-J)

Material. Fifteen specimens. HOLOTYPE - P91/137 from AMG 608985 KILGOUR; PARATYPES - P91/138, 91/140-91/151 from AMG 608985 KILGOUR, P91/139 from AMG 602162 KILGOUR.

Diagnosis. Shell exterior with fine radial ornament; interior with discrete discontinuous ridgelike comarginal thickenings, distally flexed on concave side.

Description. Shell up to 3.2 mm in length, slightly laterally compressed: aperture planar, subcircular to elliptical. Exterior with radial ornament of closely and regularly spaced fine grooves. Interior with prominent discrete comarginal ridgelike thickenings, each continuous around entire circumference of shell. Thickenings generally planar except for gentle distal flexure on concave side, incipient in apical region.

Etymology. From Kutanji aboriginal *ngalbala* (stress on first syllable) = small ribbed snail.

Remarks. Silicification in some specimens partially obscures the external ornament (Fig. 10J).

Family ?Enigmaconidae MacKinnon

?enigmaconid indet.
(Fig. 10M-O)

Material. One specimen. P91/152 from AMG 608985 KILGOUR.

Description. Shell moderately tall, laterally compressed, slightly cyrtoconic, 5 mm in length and 3 mm in height, with prominent angular to subangular comarginal rugae; rugae planar to subplanar. Aperture elongate elliptical to subrectangular, near-planar. Possible pegma anteriorly.

Remarks. The specimen is a steinkern with the apex and 'anterior' side crushed and the apertural margin incompletely preserved. There is some similarity in lateral outline with the stenothecid genera *Mellopegma* Runnegar and Jell, 1976 and *Eurekapegma* MacKinnon, 1985, but these and other stenothecids are much more compressed laterally. The damage to the 'anterior' portion of the shell is limited along a posteroventral line coinciding with the position of the pegma in *Enigmaconus* MacKinnon, 1985.

Family ?Scenellidae Wenz

?scenellid indet.
(Fig. 10K-L)

Material. One specimen. P91/153 from AMG 608985 KILGOUR.

Description. Tall, laterally compressed, slightly cyrtoconic univalve 4 mm in height, with prominent coarse, smooth comarginal rugae and associated finer, less distinct comarginal wrinkles. Aperture planar, subelliptical. Apex rounded.

Remarks. The specimen is a steinkern. Closest similarities are with *Obtusoconus* Yu, 1979 and *Ginella* Missarzhevskiy in Rozanov *et al.*, 1969. In detail, the rugation is unlike that of any defined *Obtusoconus* species. The apex is poorly preserved and the apertural margin incomplete. Like *O. foliaceus* MacKinnon, 1985 from New Zealand, it lacks the fine apical radial ornament displayed by some Chinese species.

Obtusoconus ranges from earliest Cambrian (Meishucunian of China) to late Middle Cambrian (*Ptychagnostus* cassis Zone of New Zealand). A full discussion is provided by Yu (1987). An *Obtusoconus* sp. is also figured by Runnegar (in Bengtson *et al.* 1990) from the lower Parara Limestone (Atdabanian) of Yorke Peninsula, South Australia.

Ginella Missarzhevskiy is a similarly tall conical univalve of Early to Middle Cambrian age with a planar, more rounded apertural outline.

Phylum Porifera Grant
Order Heteractinida de Laubenfels
Family Wewokellidae King

Genus *Jawonya* Kruse, 1987

Type species. *Jawonya gurumal* Kruse, 1987 [Middle Cambrian (Ordian), Tindall Limestone, Katherine, Northern Territory, Australia].

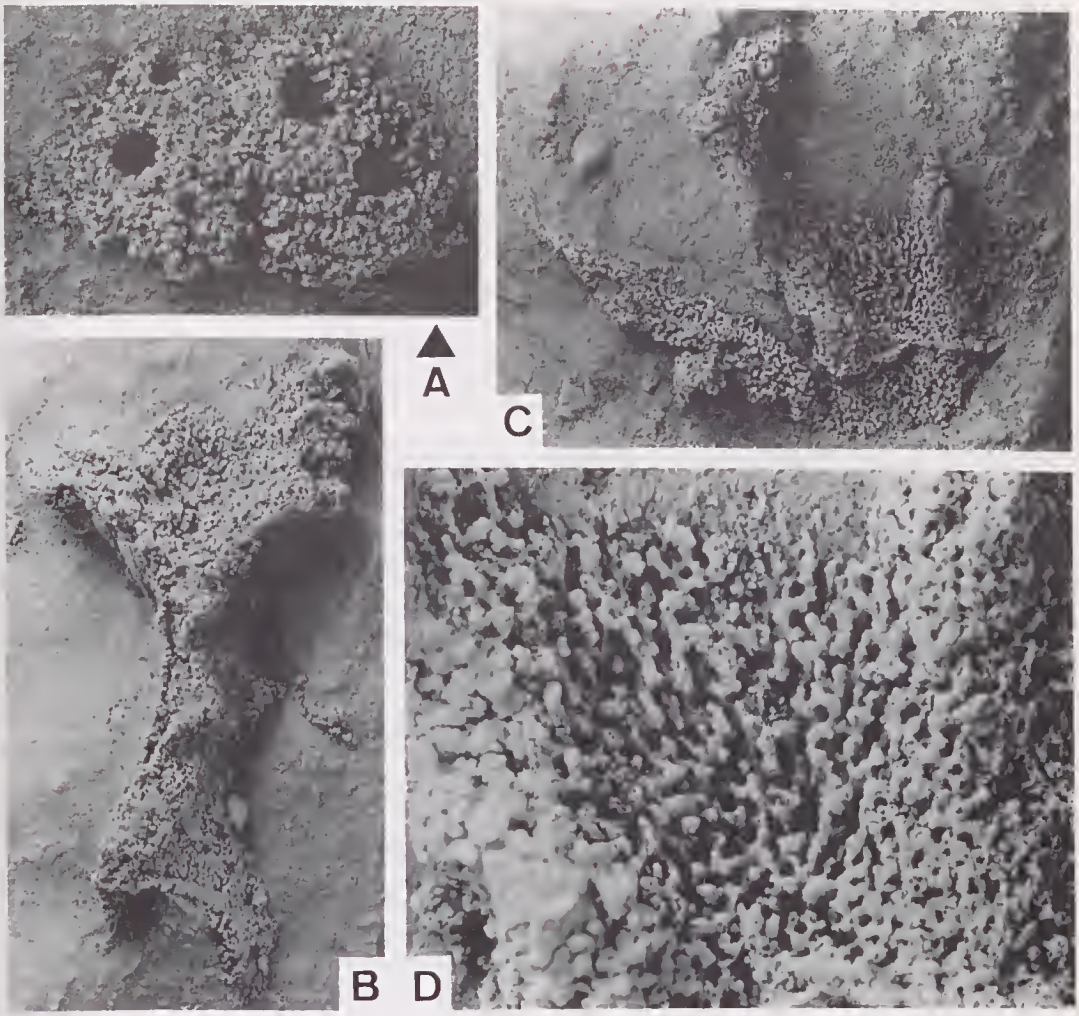

Fig. 11. *?Jawonya* sp.: **A**, specimen P91/154 from AMG 558193 KILGOUR, external view of partially exposed chamber x6. lithistide indet.: **B**, conical-explanate specimen P91/155 from AMG 558193 KILGOUR, external view showing oscule at upper right x3; **C-D**, conical-explanate specimen P91/156 from AMG 558193 KILGOUR: **C**, external view x3; **D**, detail showing quasiorthogonal spicule net x10.

?Jawonya sp.
(Fig. 11A)

Material. One specimen. P91/154 from AMG 558193 KILGOUR.

Description. Curved chamber fragment 9 mm in length, with scattered exopores spaced 0.8-2.2 mm apart. Exopores rounded, 0.5-1.0 mm in diameter, with short inward-projecting radial partitions at rims. No spicules preserved.

Remarks. The size and spacing of exopores are consistent with those of *J. gurumal* Kruse, 1987, which also shows similar radial partitions at exopore rims. However, oscule architecture is not preserved in the Top Springs Limestone specimen, so that generic assignment is questionable.

Class Demospongia Sollas
Order Lithistida Schmidt

lithistide indet.
(Fig. 11B-D)

? lithistide indet - Kruse 1990: 51, pl. 27.

Material. Two specimens. P91/155-91/156 from AMG 558193 KILGOUR.

Description. Conical-explanate sponges up to 30 mm in length. One specimen has an oscule 1

mm in diameter. Spicule net quasiorthogonal, seemingly not diverging toward walls, with a dominant longitudinal component; individual spicules obscured by silicification.

Remarks. The two silicified specimens are preserved as nuclei of onkoids in a grey onkoid limestone. They may represent a more mature growth stage of the lithistide figured by Kruse (1990) from the Tindall Limestone.

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APPENDIX

FOSSIL LOCALITIES

Outcrop and drillhole localities are listed below together with their known faunas. Northern Territory Geological Survey localities are prefixed NTGS, and were collected by the author in 1989. Drillhole DD83SC1 was drilled by CRA Exploration Pty Ltd in 1983. AMG= Australian Map Grid.

Outcrop

NTGS 4624. MALLAPUNYAH AMG 556210; grey, patchily dolomitised limestone from a 9 m-thick section on east bank of a small sinuous creek on east side of McArthur River.
echinoderm ossicles

NTGS 4625. KILGOUR AMG 558193; grey onkoid and featureless limestone, immediately west of junction of McArthur River and Kangaroo Creek.
?*Jawonya* sp.
lithistide indet.
sponge spicules

NTGS 4626. KILGOUR AMG 599162; grey 'sandy' (dolomitic) limestone with nodular silicification.
Kyrshabaktella mudedirri
sponge spicules

NTGS 4627. KILGOUR AMG 602162; partially silicified grey onkoid limestone amid a vast discontinuous limestone pavement.
Kyrshabaktella mudedirri
Latouchella cf. *accordionata*
Igorella durara
Kmanjia ngalbala
chancelloriides

NTGS 4628. KILGOUR AMG 612119; selectively dolomitised and silicified grey limestone in lower bank of McArthur River.
Westonia ?nyapungensis
Kyrshabaktella mudedirri
Hadrotreta djagoran
Eothele napuru
Micromitra nerrambawn

hyoliths indet.
echinoderm ossicles
chancelloriides
problematic tubes

NTGS 4629. KILGOUR AMG 619046; grey, patchily dolomitised limestone from east bank of McArthur River, 400 m south of creek junction.
Westonia ?nyapungensis
Kyrshabaktella nudedirri

NTGS 4630. KILGOUR AMG 635015; grey, patchily dolomitised limestone from east bank of McArthur River.
Hadrotreta djagorau

NTGS 4631. KILGOUR AMG 608985; partially silicified grey, patchily dolomitised limestone from east bank of McArthur River.
Kyrshabaktella nudedirri
Latouchella cf. *accordionata*
Igorella durara
Kutanjia ngalbala
?enigmaconid indet.
?scenellid indet.
hyoliths indet.
chancelloriides
sponge spicules

NTGS 4632. KILGOUR AMG 751189; grey, burrowed, patchily dolomitised limestone in and around sinkhole; flat terrain.
Kyrshabaktella nudedirri
Micronuitra uerranubawu (?)

NTGS 4633. KILGOUR AMG 753180; grey, burrowed onkoid limestone in 5 m-thick section exposed above banks of Letterbox Creek, on north side opposite abandoned 'Top Spring' homestead.
Kyrshabaktella nudedirri
echinoderm ossicles

NTGS 4634. KILGOUR AMG 770160; grey, burrowed limestone in low pavement on sandy plain.
Kyrshabaktella nudedirri

NTGS 4635. KILGOUR AMG 773185; grey, burrowed, patchily dolomitised limestone on main 'Top Spring' track 2.44 km east of homestead, and about 100 m southwest of visibly outcropping small pinnacle hills of Cretaceous sandstone.
Westonia ?nyapungensis
Kyrshabaktella nudedirri
Hadrotreta djagorau
Eotlele uapurn
Gudnguwau hardmani
chancelloriides
sponge spicules
problematic tubes

NTGS 4636. KILGOUR AMG 764170; grey, burrowed, patchily dolomitised limestone from pavement and rubble on low rise, on south-trending track 1 km south of creek crossing near 'Top Spring' homestead.
Kyrshabaktella nudedirri
Igorella durara (?)

NTGS 4637. KILGOUR AMG 865005; grey bioclastic lime mudstone and buff yellow-brown chert astride track about 3 km southeast of Kilgour Gorge Waterhole.
Redlichia forresti

NTGS 4638. KILGOUR AMG 984987; grey bioclastic limestone on south-facing slope of low rise, along fenceline 3.0 km south of No.1 Bore.
Redlichia forresti (?)
Kyrshabaktella nudedirri
Diraphora sp.
Gudnguwau hardmani
hyoliths indet.
chancelloriides
echinoderm ossicles

NTGS 4639. KILGOUR AMG 985988; grey, silicified nodular limestone from low pavement on fenceline 2.4 km south of No.1 Bore and about 100 m south of northwest-southeast fence.
Kyrshabaktella nudedirri

NTGS 4640. KILGOUR AMG 000058; grey, burrowed onkoid limestone from side of 'Mallapunyah'-'Kiana' track, where north-south fence leading to No.1 Bore intersects road.
Kyrshabaktella nudedirri
echinoderm ossicles

NTGS 4641. LANCEWOOD AMG 094005; grey nodular-silicified limestone from 1.5 m-high towers above grey onkoid limestone pavement on sandy plain, east side of track about 300 m south of No.4 Bore.
Westonia ?nyapungensis
Kyrshabaktella nudedirri
Hadrotreta djagorau
sponge spicules

NTGS 4642. LANCEWOOD AMG 190988; grey bioclastic limestone on north side of creek.
Kyrshabaktella nudedirri
echinoderm ossicles

Drillhole

DD83SC1. KILGOUR AMG 884883; Spear Creek.
Sample depths subsurface:

31 m	*Kyrshabaktella nudedirri*
40 m	*Kyrshabaktella nudedirri* (?)
	Hadrotreta djagorau
47 m	*Westonia ?nyapungensis*
	Kyrshabaktella nudedirri
57 m	*Kyrshabaktella nudedirri* (?)
	echinoderm ossicles
63 m	*Kyrshabaktella nudedirri*
74 m	*Kyrshabaktella nudedirri*
	monoplacophoran indet.
88 m	*Kyrshabaktella nudedirri*